

DOCUMENT RESUME

ED 314 201

PS 018 527

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TITLE Discrimination and Imitation of Facial Expressions by Neonates.
PUB DATE Aug 89
GRANT MH00331; MH40779
NOTE 36p.; Paper presented at the Annual Meeting of the American Psychological Association (New Orleans, LA, August 11-15, 1989).
PUB TYPE Reports - Research/Technical (143)
EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Affective Behavior; Biological Influences; *Facial Expressions; Imitation; *Individual Development; *Individual Differences; *Infants; Models; *Neonates; Premature Infants; Twins

ABSTRACT

Findings of a series of studies on individual differences and maturational changes in expressivity at the neonatal stage and during early infancy are reported. Research results indicate that newborns are able to discriminate and imitate the basic emotional expressions: happy, sad, and surprised. Results show widened infant lips when the happy expression is modeled, pouting lips when a sad face is modeled, and a widely opened mouth and widened eyes in response to a surprised face. Even preterm infants as young as 32 weeks of age can imitate these facial expressions. Like adults, however, some infants are very expressive and some are poker-faced. Monozygotic twins show discrimination and imitation abilities that are more similar than those of dizygotic twins. It is concluded that these data suggest a genetic predisposition for varying degrees of emotional expressivity that appear as early as birth. (RH)

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Discrimination and imitation
of facial expressions
by neonates

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Acknowledgements

This research was supported by NIMH Research Scientist Award
#MH00331 and NIMH Basic Research grant #MH40779 to Tiffany Field.
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Abstract

Newborns are able to discriminate and imitate the basic emotional expressions happy, sad and surprised. They show widened lips when the happy expression is modeled, pouting lips to a sad face and a wide open mouth and widened eyes when they see a surprised face. Even preterm infants as young as 32 weeks can imitate these facial expressions. Like adults, however, some infants are very expressive and some are poker-faced. Monozygotic twins show more similar discrimination and imitation abilities than dizygotic twins. These data combined suggest that there is a genetic predisposition for varying degrees of emotional expressivity that appears as early as birth.

Expressivity and the ability to produce and discriminate facial expressions appears to differ across individuals as early as birth. These differences may relate to individual characteristics such as temperament, autonomic reactivity, and social responsivity. As might be expected, maturational changes in expressivity and the production and discrimination of facial expressions occur within individuals across early development. This chapter is a brief review of research by others and by our group on individual differences and maturational changes in expressivity at the neonatal stage and across early infancy.

Individual differences in expressivity

A model for individual differences in expressivity

The overt emotional expressions and electrodermal responses of infants to stimuli such as a live rat, buzzers, and bells were studied decades ago by Jones (1950). Consistent patterns of overt expressivity and autonomic reactivity were noted which Jones labeled "internalizer", "externalizer", and "generalizer" (Jones, 1950). (See Table 1 for model). Internalizers had frequent galvanic responses but were not overtly expressive, while externalizers were the opposite. Generalizers were both overtly and internally

responsive. Infants were extraverted by nature according to Jones (1960), but during early and later childhood Jones suggested children increasingly control or inhibit their overt expressions and electrodermal responses increase.

Insert Table 1 about here

This model appears to be consistent with that of Eysenck (1967) who noted in a series of studies with adults that facially expressive adults show low level physiological responses. In addition, they rate themselves as more extraverted, have higher thresholds to stimulation and are more difficult to condition. By contrast, introverted adults are less expressive facially, have lower thresholds to stimulation, show considerable physiological responsivity to stimulation and are more readily conditioned. Eysenck (1967) suggested that introverts have a lower threshold to activation of the ascending reticular activating system (ARAS) and therefore are more readily conditioned or sensitive to socialization influences. During socialization, overt responses are inhibited and thus the negative relationship between overt expression and electrodermal responding develops in the introverted person. The lower thresholds of the ARAS, and the propensity to introversion, however, is seen as an

innate process by Eysenck (1967). The internalizing/externalizing mode of expressivity may be present from birth and merely reinforced or attenuated by socialization experiences.

Individual differences in neonatal facial expressivity

In a study by Field, Woodson, Greenberg and Cohen, (1982) on the production and discrimination of facial expressions by neonates, thresholds to stimulation and physiological activity were recorded to determine the extent to which neonates' physiological reactivity was related to facial expressiveness. In this study 74 sleeping neonates were observed for the following behaviors: sleep state, activity level, facial expressions, and heart rate. A series of 5 pin-pricks was then administered as in the Brazelton Neonatal Behavior Assessment Scale (Brazelton, 1973), to determine the sleeping neonates' threshold for tactile stimuli. The neonates' cry sounds were recorded for measures of latency to cry and cry duration. A series of buzzer tones were then presented to determine the infants' thresholds for auditory stimulation based on the infants' cardiac responses. These were followed by an administration of the Brazelton scale. Finally, the neonates' discrimination between three facial expressions (happy, sad, and surprised) were assessed during a trials-to-criterion habituation procedure.

During the faces discrimination procedure, the

model held the neonate in an upright position with the newborn's face located approximately 10 inches from her face. The newborn's visual fixation on the adult's face and the facial movement patterns were recorded by an observer who stood behind the model in order to see the infant's face but remain unaware of the expression being modeled. In order to sustain the newborn's alertness and elicit the newborn's visual fixations on the model's face, the model provided vestibular stimulation (two deep knee bends) and auditory stimulation (two tongue clicks) prior to each trial. The model then fixed one of these expressions on her face: a happy, sad, or a surprised expressions. (See Figure 1 for modeled expressions and infant responses). Face one was sustained in a fixed position until the infant looked away from the model's face at which time the model re-elicited the neonate's visual fixation with vestibular and auditory stimulation. Face one trials were repeated until the neonate looked at that face for less than 2 seconds. Face two and face three trials were then presented using the same trials-to-criterion habituation procedure.

Insert Figure 1 about here

As was noted by Field et al. (1982), widened eyes

and wide mouth opening occurred for a greater proportion of the surprise than the other face trials. Lip widening occurred more frequently during happy face trials, and tightened mouths/protruding lips and furrowed brows occurred more frequently during the sad expression trials (See Figure 2).

Insert Figure 2 about here

To investigate individual differences in infant expressivity during this procedure, infant expressivity was rated by the observer during the course of the face imitation/habituation paradigm on a 5-point Likert-type scale (1 = nonexpressive, 5 = extremely expressive). The infants were then divided at the rating of 2 (low expressive) which by chance yielded a median split of the sample with half of the infants ($N = 37$) having received ratings of 1 or 2 and half receiving ratings of 3 or greater.

Analyses of differences between the low and high expressive infants yielded the following (See Table 2): a) high expressive infants showed more frequent imitative expressions, e.g., more frequent widened lips during happy face trials, more frequent furrowed brows and protruded lips during sad expressions, and more eye and mouth widening during surprised expressions; b) high

expressive infants' facial expressions were guessed accurately at greater than chance proportions of the time; c) high expressives looked longer during the later trials of the series of faces; d) high expressive infants had a lower mean heart rate but higher heart rate variability during sleep; e) high expressive infants received more optimal Brazelton interaction, state organization and response to stress scores; and f) high expressive infants had a shorter mean latency to cry during the pin-prick procedure.

Insert Table 2 about here

The high expressive infants in this study were apparently more socially responsive during the Brazelton interaction items and were more modulated or less irritable in their responses to stimulation particularly to stressful stimulation during the Brazelton assessment. Although the Brazelton data would suggest that the high expressive infants were less aroused, showing higher sensory thresholds and less intense responses to stimulation, a larger sample would be required for analyses of responses to specific items of the Brazelton. The lower mean heart of the high expressive infants during sleep together with their greater heart rate variability is similar to data by

Coll (1981) who found that infants who were uninhibited in their expressivity had lower resting mean heart rate but greater heart rate variability. During auditory stimulation trials the high expressive infants also showed lower mean heart rate but greater heart rate variability. Unfortunately, neither our group nor Coll (1981), because of concerns about movement artifacts, collected heart rate data during the actual procedure for which the expressive or uninhibited behaviors were collected. These kind of data would more directly assess the hypothesized negative relationship between facial expressivity and autonomic reactivity.

That the high expressive infants looked longer at the face stimuli during the later trials suggests that they were less readily habituated to the face stimuli, a result that is somewhat similar to Eysenck's (1967) data on extraverted adults who were more typically less readily conditioned. The significant individual differences between high and low expressive infants on their attentiveness, responsivity to social stimulation, autonomic reactivity, and accuracy of mimicry soon after birth are suggestive of an externalizer/internalizer typology (Jones, 1950) or the extraverted/introverted distinction proposed by Eysenck (1967). The expressive infants were less reactive autonomically, had higher thresholds and were less readily habituated to face stimuli. A more direct assessment of the externalizer/internalizer question requires more precise

measurement of sensory thresholds and the habituation process and simultaneous measurement of autonomic and overt behaviors during the faces procedure.

Greater concordance in monozygotic versus dizygotic twins on neonatal expressivity

To further explore the question of individual differences in neonatal face perception and production abilities, monozygotic and dizygotic twins were subjected to the face discrimination/imitation procedure already described. The sample was comprised of 56 twins (28 monozygotic and 28 dizygotic twins). The MZ and DZ samples of twins were equivalent on gestational age ($M = 37$ weeks). As in the previously described habituation/imitation procedure, the neonates were first given a Brazelton assessment to bring them to an alert state and then provided a series of facial expressions.

For the data base in general, the analyses revealed greater concordance within the monozygotic twin pairs than within the dizygotic twin pairs. With respect to the habituation data, the mean number of trials to habituation and the mean looking times per trial did not differ between the monozygotic and dizygotic twin groups. However, the difference scores between individual infants within twin dyads were greater for the dizygotic twins than for the monozygotic twins. The average difference scores for mean looking time during the happy face trials was 2.5 seconds for the

monozygotic twins and 5.5 seconds for the dizygotic twins. In the case of the sad face trials, the mean difference score between twins within monozygotic twin pairs was again smaller than within dizygotic twin pairs (2.6 seconds vs. 5.6 seconds). Finally, for the surprised face trials, the mean difference score between twins within monozygotic twin pairs was also less than it was for the mean difference score within dizygotic twin pairs (2.9 seconds vs. 7.5 seconds). Thus for mean looking times greater differences were noted between the infants of dizygotic pairs than the infants of monozygotic pairs.

Similarly, for the 5-point expressivity rating, there was a greater difference observed in expressivity between twins belonging to dizygotic twin pairs than between twins belonging to monozygotic twin pairs (1.8 vs. 1.0). Finally, for the measure of accuracy with which the model's facial expressions could be guessed by looking at the expression on the neonate's face, there was a similarly greater discordance among the dizygotic twins. This was suggested by differences on the percentage of discordance between twins within pairs on whether or not their expressions were accurately guessed. For the happy face expression trials the discordance rate for dizygotic twins was 60% versus 43% for the monozygotic twin pairs. For the sad expression trials again the discordance was greater for dizygotic

twin pairs than for monozygotic twin pairs (71% vs. 43%). Finally, for the surprised facial expressions, only 30% of the monozygotic twin pairs were discordant on this measure as opposed to 60% of the dizygotic twin pairs. Thus, it would appear that there was greater concordance among the twins of monozygotic pairs than dizygotic pairs on mean looking time during the facial expression habituation trials, on their expressivity rating and on the accuracy with which their happy, sad and surprised expressions could be guessed. These data on the greater concordance of expressivity in newborn monozygotic versus dizygotic twins provide, then, additional support for the observation that individual differences in expressivity occur as early as birth.

Although Jones (1960) and Eysenck (1967) have speculated that individual differences in expressivity are innate, the evidence from our studies is only weakly supportive. Clearly, a more direct investigation of the externalizer/internalizer typology and a longitudinal study from the neonatal stage to at least the preschool years is needed to trace the origins and development of individual differences in expressivity. Nonetheless, these data do underscore the importance of detecting early individual differences in expressivity. Expressive neonates appear to begin life with the advantage of being more socially responsive as evidenced by their superior Brazelton interaction scores which, in turn, contribute to better interactions with their

parents. At the preschool stage more expressive children are more popular and experience more positive social interactions with their peers (Buck, 1975; Field & Walden, 1982). In addition to experiencing less difficulty interacting with their peers, expressive, externalizer children, may experience less physiological arousal and less stress-related disease and may show more empathy. While speculative, these possibilities highlight the need for more intensive and longitudinal research on individual differences in expressivity.

Maturational changes in infant expressivity

Because maturational changes occur by definition across early development, one might expect considerable maturational changes in infant expressivity. However, there are virtually no studies on maturational changes in expressivity during early infancy. Malatesta and Haviland (1982) have documented changes in the incidence of different facial expressions and Oster and Ekman (1978) have alluded to the development of facial expression blends during infancy. In addition, a number of longitudinal studies on individual infants such as those by Piaget (1952) and by Wolff (1987) describe increasing expressivity across early infancy. However, empirical data are lacking in this area. To begin to address the question of maturational changes in infant expressivity, our studies have focused on the differences between preterm and term infants in their

expressions elicited during the Brazelton assessment and during the habituation/imitation of faces paradigm. In addition, data will be reviewed from a study that observed the same infants across the first six months of life in the habituation/imitation faces paradigm.

Facial expressions of term and preterm infants during Brazelton assessments

According to Oster and Ekman (1978), the neonate's facial musculature is sufficiently developed to form all the basic facial expressions (happy, interested, surprised, afraid, disgusted, angry, and sad). Less mature neonates may emit facial expressions less frequently or with less specificity than term neonates. To determine maturational differences in the incidence of the basic facial expressions, the expressions of both term neonates and healthy preterm neonates were recorded during Brazelton assessments shortly after birth by videotaping those expressions as the Brazelton scale was administered (Field, Greenberg, Woodson, Cohen & Garcia, 1984).

The sample for this study was comprised of 96 neonates (48 term, 48 preterm neonates). The preterm infants averaged 35 weeks gestational age and 2400 grams birthweight and were considered healthy preterm neonates. Their expressions were videotaped during an administration of the Brazelton scale.

The facial expressions of interest, disgust,

sadness, and crying were the predominant affects observed during the reflex items. The predominant affect displayed during the orienting items was clearly that of interest. Many of the patterns noted in the study were similar for the term and preterm neonates. For example, virtually the same predominant expression observed during particular reflex and orienting items occurred for both term and preterm neonates. The same constellations of reflexes elicited interested, disgusted, sad, and crying responses in both term and preterm infants. Thus, the preterm infants seemed to respond differentially to the stimuli with what appeared to be stimulus-specific expressions in the same way that the term infants had responded. However, there were also a number of differences in the data on the term versus preterm infants. Fewer preterm than term babies emitted distinctive, codable expressions. Whether this relates to less organized responses, less control over facial musculature, lesser attentiveness during the examination, higher sensory thresholds, less developed reflex responses, less motor maturity or motor activity is not clear at this time. A related observation is that fewer of the preterm infants cried during these reflex maneuvers, particularly to those noted to be aversive for the term infants including constellations of ankle clonus and passive movements as well as incurvation and crawling.

During the orienting items, a greater number of preterm infants (59% vs. 49%) showed interested facial expressions and a smaller number of preterm infants (15 vs. 24%) showed disgusted facial expressions. The greater incidence of interested facial expressions may simply relate to slower habituation of the preterm infants to the orienting stimuli. Finally, a greater percentage of preterm infants showed interested facial expressions in response to the inanimate orienting stimuli (the rattle and ball) relative to the term infants, who instead showed more frequent interested facial expressions in response to the animate orienting stimuli (the examiner's face and the examiner's face and voice). Although visual fixations were not recorded in this study, the lesser incidence of interested faces to the animate stimuli may relate to less looking at the animate stimuli. Less frequent looking at faces has been noted for preterm versus term infants by other investigators (Field, 1979; Masi & Scott, 1982). Alternatively, it may have simply required a longer time to recruit attentive behavior in the preterm infants or it may have taken a shorter time for the term infants to habituate. These possibilities are suggested by the increase of the interest facial expressions for the preterm infants and a decrease for the term infants across the order of presentation.

In general, and in this study as well, the order of presentation of the orienting stimuli is face and voice,

voice, face, rattle, and ball proceeding from the presumably more interesting animate stimuli to the less interesting inanimate stimuli. Interested facial expressions increased across this order for preterm infants and decreased for term infants. Thus, as has already been noted, the potential confound of amount of visual attentiveness is problematic and suggests that visual behavior should also be coded in a future study. Several of the preterm infants' responses, such as disgusted faces and crying, may have been artifactually low given their longer response latencies and our inclusion of only immediate responses in the analyses. Thus, it would appear from these data that there are minimal maturational changes between 35 weeks of gestational age and 40 weeks, with preterm infants being almost as expressive and their expressions being almost as stimulus-specific as those of their term infant peers.

Imitation of facial expressions by term and preterm neonates

In the study already described on discrimination and imitation of facial expressions by term neonates (Field et al., 1982) the neonates discriminated happy, sad and surprised facial expressions in a trials-to-criterion habituation/dishabituation paradigm. The expressions posed by a live model were guessed at a greater than chance frequency by an observer who saw

only the face of the neonate. Movements in different regions of the face suggested that neonates are capable of imitating at least those basic facial expressions. In a more recent study Field et al. (1983) demonstrated the same imitation abilities by healthy preterm neonates using the same paradigm.

This study included a group of preterm infants (mean gestational age = 35 weeks and mean birth weight = 2200 grams) as compared to a group of term neonates. Analyses of the facial expression data revealed that the preterm infants also showed more frequent widening of the lips during the happy expression model, pouting of the lips or protruded lower lips more often in the presence of the sad expression model, and wide open mouths more frequently during the surprised expression. Although brow and eye movements also occurred differentially across expressions in the expected fashion, differences in their frequencies were not statistically significant. Surprise and sad expressions were accurately guessed more frequently than happy expressions, although all the expressions were accurately guessed in the preterm group at significantly greater than chance level (See Figure 3). The only difference between the term and preterm infant groups on the imitation data was the surprising finding that the surprise expressions of the preterm infants were accurately guessed more frequently than those of

term infants, possibly because the preterm infants showed wide open mouth movements more frequently during the modeling of the surprise expression. No differences were noted between the preterm and term infants on the 5-point Likert scale ratings of expressivity, suggesting that they were observed to be equally as expressive as the term infants. Anecdotally, however, the observers noted that many of the facial expressions of the preterm infants were more exaggerated. This would not be surprising if researchers find, as they have speculated, that with development and socialization, facial expressions become less exaggerated, more finely tuned and subtle.

Insert Figure 3 about here

That the preterm infants were capable of discriminating these different facial expressions as well as showing some evidence of imitation of the expressions, suggests that these abilities are present even prior to term age. Given that the necessary muscle movements are present in preterm infants, this is perhaps not surprising (Oster & Ekman, 1978). Spontaneous expressions of this kind have been noted even during the reflex testing of fetuses at even earlier gestational ages. The preterm infants did appear to be handicapped, however, by less developed

attentional processes. During the facial expression-imitation procedure there was less evidence for habituation by the preterm infants. Because preterm infants look for shorter periods of time per trial, they may simply require a greater number of trials to demonstrate habituation. That habituation is not required for discrimination to have occurred is suggested by the findings of Fagan (1974) who demonstrated discrimination using the paired comparison technique in a shorter period of time than is typically required by an habituation paradigm. The preterm infants were presumably making some form of discrimination between the facial expressions prior to the demonstration of imitation.

Changes in expressive behavior during early infancy

As has already been noted, very little is known about the subsequent maturational changes in expressivity and imitative abilities in the months that follow birth. Thus, Field et al. (1986) conducted a study to assess the development of imitative behavior in a longitudinal sample seen every month from the age of two months to six months. The same facial expressions (happy, sad, surprised) and the same paradigm as had been used in the Field et al. (1982, 1983) studies were used in this longitudinal investigation. The sample was comprised of 40 normal infants who were seen every month between the ages of two and six months. The only

departure from the neonatal procedure was that the infants, because they were heavier, were positioned in a semi-upright infant seat placed on a table in a face-to-face position across from the model's face.

The results suggested that looking time, correspondence between the mouth expression of the infant and the mouth expression of the model, accuracy of the observer's guess, and expressivity ratings decreased from 2-3 to 4-6 months. Although the infants' matching mouth movements with the modeled mouth movements and the accuracy of the observers' guessing were greater than chance at each observation period, the less frequent mimicry, less accurate guessing, and less expressivity at the older ages suggest that imitative behavior declined across early infancy (See Table 3 and Figure 4). Given that interest in the model's expressions also diminished, as manifested by decreased looking times, ^{the} imitative behavior and interest/attentiveness would appear to be related. An alternative possibility raised by the data of Malatesta and Haviland (1982) as well as those of Oster and Ekman (1978) is that blends of these facial expressions are developing such that they are less frequently emitting exaggerated mouth movements of happy, sad, and surprised expressions. Thus, they may have been rated as less expressive, and mimicry of mouth movements may have been noted less frequently due to this development of facial expression blends.

Insert Tables 3 and 4 about here

In order to detect more subtle developmental changes additional components of expressions may need to be coded, for example, movements in the brow and eye regions, and a more finely tuned coding system may be necessary. Because a developmental decline in imitative behavior was noted in this study in which as many as 40% of the infants were good imitators or consistently emitted expressions that could be accurately guessed as imitations of the mouth across the six month period, these data do not support Field et al.'s notion that previous studies showed declines in imitation because of potential individual differences in cross-sectional samples. Thus, it is not clear from this study whether the decline in imitative behavior derived from lesser interest in the static face (unlike the typically animated face), from the development of facial expression blends, or from a simple developmental shift from reflex-like behavior to more natural interactive responses to the model's behavior, for example, a puzzled expression occurring in response to a fixed, surprised expression. The limitations of this paradigm may simply be too great for assessing the longitudinal development of the infant's imitation during early

infancy. That expressivity declined in this study in which infants were basically being asked to mimic fixed facial expressions, while expressivity has been noted to increase across early infancy in the naturalistic context of mother-infant interactions (Field, Vega-Lahr, Goldstein & Scafidi, 1987; Malatesta & Haviland, 1982) highlights the limitations of this paradigm for capturing maturational changes in expressivity.

Summary

In summary, the individual differences noted in our imitation studies and the greater concordance between monozygotic than dizygotic twins on their looking times and their expressivity suggest that individual differences in expressivity occur as early as birth, possibly due to genetic differences. The significant individual differences between high and low expressive infants on their attentiveness, responsivity to social stimulation, and autonomic reactivity, suggest that neonates may differ on a broader dimension than simply their expressivity, highlighting the complexity of individual differences in neonatal behavior. That expressivity, or some other more complex dimension such as extraversion, may be innate, as has been suggested by Jones (1960) and Eysenck (1967), suggests that there may be continuity on this dimension. However, longitudinal studies on the development of expressivity, whether that turns out to be continuous or changing, will require the design of paradigms that can accommodate shifts in the

contexts that seem to elicit optimal expressivity. As was noted earlier, the still-faced models used at the neonatal stage were not effective elicitors of expressive and imitative behavior at later times in early infancy. Further, in our current paradigms the considerable effects of socialization experiences on expressivity are not being tapped. Thus, while there may be continuity in individual differences and maturational changes in expressivity, these are difficult phenomena to explore with our existing paradigms. Nonetheless, the apparent effects of expressivity differences on social and emotional development as well as the development of empathy challenge us to develop those paradigms to further understand this complex phenomenon.

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Table 1

A Model for Individual Differences in Expressivity

<u>Internalizer</u>	<u>Generalizer</u>	<u>Externalizer</u>
low threshold	moderate threshold	high threshold
high physiological reactivity	moderate physiological reactivity	low physiological reactivity
low expressivity	moderate expressivity	high expressivity
rapid conditioning	moderate conditioning	slow conditioning

Table 2

Means for High and Low Expressivity Groups (All means significantly different at $p < .05$)

	Expressivity	
	Low	High
<u>Threshold</u>		
# Pinpricks to response	1.2	1.9
<u>Expressivity</u>		
% Accuracy guesses	.48	.80
% Happy - mouth widens	.05	.14
% Sad - lip protrusion	.08	.22
% Surprise - mouth open	.20	.44
<u>Physiological responsivity</u>		
HR variability (BPM)	32	23
<u>Habituation</u>		
# Trials to criterion	7	11
Looking time (seconds)	10	16

Table 3 Means, F values and p levels for measures (different letter subscripts indicate significant differences in post hoc comparisons by Bonferroni t tests; p levels * $p < .05$, ** $p < .01$, *** $p < .001$)¹.

MEASURE	OBSERVATION PERIOD					F value
	2 MOS.	3 MOS.	4 MOS.	5 MOS.	6 MOS.	
# TRIALS ²	5.7	6.0	5.9	6.1	6.1	N.S.
LOOKING TIME (Secs.)						
HAPPY FACE	57.2a ³	65.4a ⁴	33.1b	28.7b	24.8b	14.13***
SAD FACE	42.0a	34.3a	23.3b	25.3b	20.9b	8.58**
SURPRISED FACE	46.0a	41.4a	32.0b	33.8b	24.2b	5.21*
MOUTH EXPRESSION ⁵						
HAPPY MODEL/WIDENED LIPS	.38a	.33a	.25b	.23b	.22b	4.71*
SAD MODEL/POUTING LIPS	.37a	.35a	.23b	.21b	.20b	5.34*
SURPRISED MODEL/WIDE OPEN LIPS	.32a	.30a	.16b	.21b	.23b	4.19*
EXPRESSIVITY RATING	3.4a	3.0ab	2.5b	2.5b	2.5b	4.23*
ACCURACY OF GUESS						
HAPPY	.83a	.87a	.62b	.63b	.67b	5.17*
SAD	.78a	.84a	.67b	.68b	.67b	4.42*
SURPRISED	.80a	.77a	.66b	.63b	.69b	4.85*

¹These comparisons were made by testing each age mean against every other age mean.

²Mean number trials were collapsed across expressions inasmuch as # trials did not vary across expressions.

³Significantly longer looking time for happy face than sad or surprise face at 2 mos, $F_5=5.81$, 4.97, $p < .05$.

⁴Significantly longer looking time for happy face than sad or surprise face at 3 mos, $F_5=7.76$, 7.59, $p < .01$.

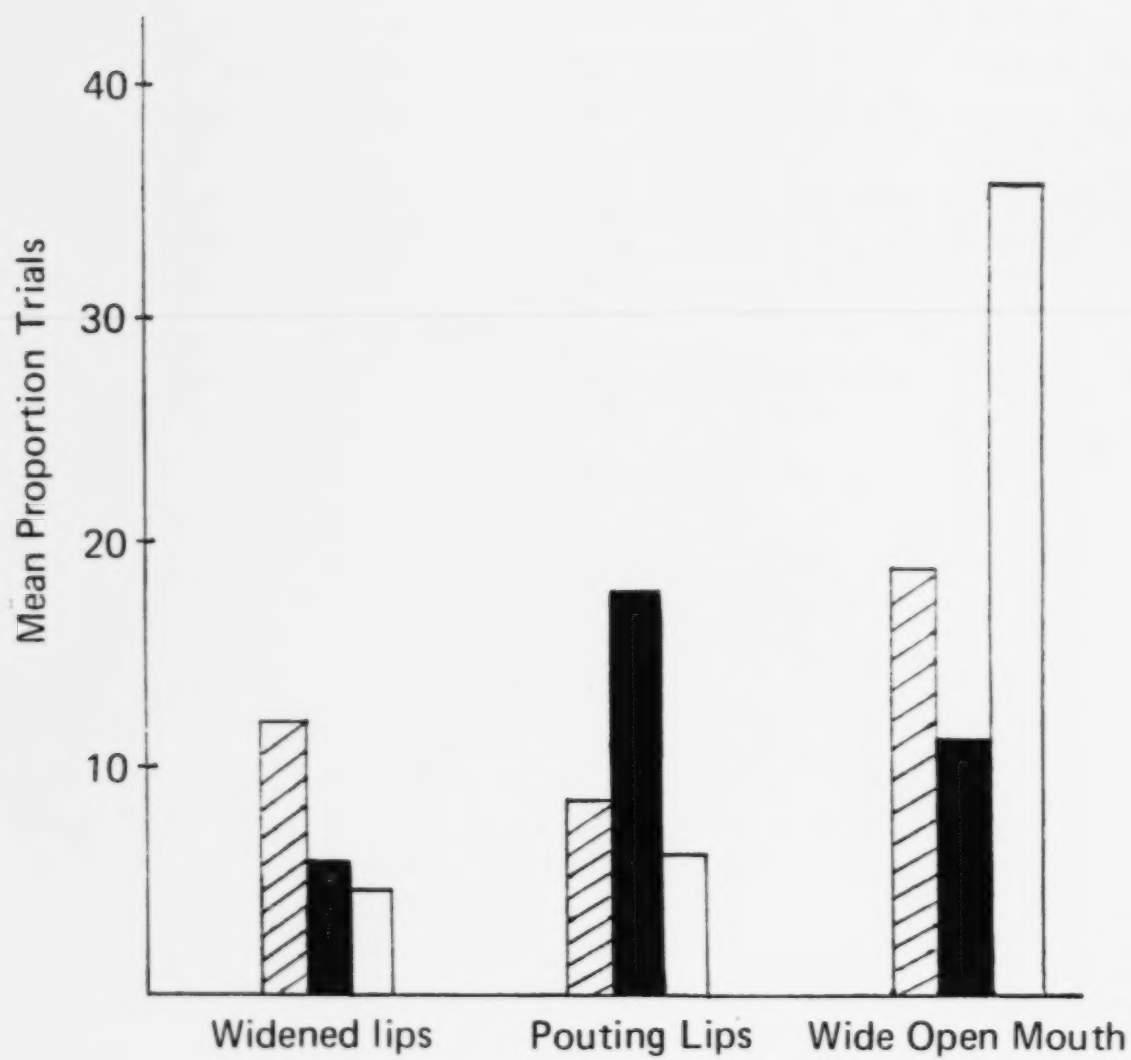
⁵Figures for this measure are % trials mouth expression emitted by infant corresponded to mouth expression modeled. For example, in the 2-month-old happy model cell .38 is the mean proportion of trials in which there was a correct response.

Figure Captions

- Figure 1 Sample photographs of a model's happy, sad, and surprised expressions and an infant's corresponding expressions.
- Figure 2 Mean proportion of trials during which different neonatal mouth movements occurred as a function of facial expression modeled ( happy,  sad,  surprised). Mouth movements include widened lips (as in happy expression), pouting lips (sad), and wide-open mouth (surprised).
- Figure 3 Percentage accurate guesses of facial expression being modeled for term (T) and preterm (PT) infants.
- Figure 4 Mean proportion of trials over 2 to 6-month observation periods that different infant mouth movements occurred as a function of facial expression modeled (HA = happy, SA = sad, and SU = surprised). Infant mouth movements include widened lips (as in a happy expression), pouting lips (sad) and wide-open mouth (surprised).



Fig. 1. Sample photographs of a model's happy, sad, and surprised expressions and an infant's corresponding expressions.



Model
▨ Happy
■ Sad
□ Surprised

